

We claim:

1. A crosslinker for organic coatings, comprising the reaction product of

(a) an amino resin comprising reactive groups selected from the group consisting of alkoxyalkyl, alkylol, and mixtures thereof;

5 (b) an olefinically unsaturated compound having a functional group reactive toward the reactive groups on the amino resin; and

(c) a silicon-containing compound having a functional group reactive toward the reactive groups on the amino resin.

2. A crosslinker according to Claim 1, wherein the amino resin comprises a melamine formaldehyde resin.

3. A crosslinker according to Claim 2, wherein the melamine formaldehyde resin has a number average molecular weight of up to about 2000.

4. A crosslinker according to Claim 1, wherein the olefinically unsaturated compound comprises one or more compounds selected from the group consisting of hydroxyl-functional olefins, hydroxyalkyl esters of unsaturated carboxylic acids, amino-functional olefins, and hydroxyalkyl
5 amides of unsaturated carboxylic acids.

5. A crosslinker according to Claim 4, wherein the olefinically unsaturated compound comprises one or more hydroxyalkyl esters of acrylic or methacrylic acid.

6. A crosslinker according to Claim 5, wherein the olefinically unsaturated compound is selected from the group consisting of hydroxyethyl acrylate, hydroxyethyl methacrylate, hydroxypropyl acrylate, hydroxypropyl methacrylate, and mixtures thereof.

7. A crosslinker according to Claim 1, wherein the silicon-containing compound comprises a silicon atom to which an alkyl chain is attached, said alkyl chain being substituted with a functional group reactive toward the reactive groups on the amino resin.

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$$\begin{array}{c} \text{R} \\ | \\ \text{R}-\text{Si}-\text{O}-\text{Si}-\text{O}-\left[\begin{array}{c} \text{R} \\ | \\ \text{Si}-\text{O} \\ | \\ \text{R} \end{array} \right]_y-\text{Si}-\text{R} \\ | \\ \text{R} \end{array} \quad \begin{array}{c} \text{R} \\ | \\ \text{R}_1 \\ | \\ \text{O} \\ | \\ \left[\begin{array}{c} \text{C}=\text{O} \\ | \\ \text{R}_2 \\ | \\ \text{C}=\text{O} \\ | \\ \text{O} \\ | \\ \text{R}_3 \\ | \\ \text{O} \end{array} \right]_n \\ | \\ \text{H} \end{array}$$

- 34

9. A crosslinker according to Claim 1, comprising 2 or more olefin functional groups.

10. A crosslinker for organic coatings, comprising:

an amino resin core; and

as substituents on the melamine core --

one or more olefin functional groups;

at least one silicon-containing group; and

at least one group selected from the group consisting of

alkoxyalkyl, alkylol, and mixtures thereof.

11. A crosslinker according to Claim 10, wherein the substituents on the melamine core comprise more than one olefin functional group.

12. A crosslinker according to Claim 10, wherein the substituents on the melamine core comprise two or more olefin functional groups.

13. A coating composition, comprising

one or more organic resins comprising functional groups reactive
toward alkoxyalkyl groups or alkylol groups; and
a crosslinker composition comprising

5 at least one functionalized crosslinker comprising

an amino resin core; and

as substituents on the core:

one or more olefin functional groups;

at least one silicon-containing group; and

10 at least one group selected from the group consisting
of alkoxyalkyl, alkylol, and mixtures thereof.

14. A coating composition according to claim 13, wherein the
crosslinker composition further comprises a second crosslinker different from
the functionalized crosslinker and comprising a plurality of functional groups
reactive toward at least some of the functional groups on the one or more
5 organic resins, in such amounts that from about 0.1% to about 20%, on an
equivalent basis, of the resin reactive functional groups of the crosslinking
composition are contributed by the functionalized crosslinker.

15. A crosslinking composition according to Claim 14, wherein 0.1 -
10%, on an equivalent basis, of the resin reactive functional groups in the
crosslinking composition are contributed by the functionalized crosslinker.

16. A crosslinking composition according to Claim 14, wherein from 0.1 to 3%, on an equivalent basis, of the resin reactive functional groups in the crosslinking composition are contributed by the functionalized crosslinker.

17. A crosslinking composition according to Claim 14, wherein the functionalized crosslinker has two or more olefin functional groups.

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curing the applied mixture with ultraviolet radiation;

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20. A method according to Claim 18, wherein the melamine formaldehyde resin has a molecular weight of up to about 2000.

21. A method according to Claim 18, wherein the olefinically
unsaturated compound comprises one or more compounds selected from the
group consisting of hydroxyl-functional olefins, hydroxyalkyl esters of
unsaturated carboxylic acids, amino-functional olefins, and hydroxyalkyl
5 amides of unsaturated carboxylic acids.

22. A method according to Claim 21, wherein the olefinically
unsaturated compound comprises one or more hydroxyalkyl esters of acrylic
or methacrylic acid.

23. A method according to Claim 18, wherein the silicon containing
compound comprises a silicon atom to which an alkyl chain is attached, said
alkyl chain being substituted with a functional group reactive toward an
alkoxymethyl group.

$$\begin{array}{c} \text{R} \quad \text{R} \quad \left[\begin{array}{c} \text{R} \\ | \\ \text{Si} \\ | \\ \text{R} \end{array} \right] \quad \text{R} \\ | \quad | \quad \quad \quad | \\ \text{Si} \quad \text{Si} \quad \text{Si} \quad \text{Si} \\ | \quad | \quad \quad \quad | \\ \text{R} \quad \text{R}_1 \quad \quad \quad \text{R} \\ | \quad | \quad \quad \quad | \\ \text{O} \quad \text{O} \quad \quad \quad \text{O} \\ | \quad | \quad \quad \quad | \\ \left[\begin{array}{c} \text{C}=\text{O} \\ | \\ \text{R}_2 \\ | \\ \text{C}=\text{O} \\ | \\ \text{O} \\ | \\ \text{R}_3 \\ | \\ \text{O} \end{array} \right] \\ | \quad | \quad \quad \quad | \\ \text{H} \quad \text{H} \quad \quad \quad \text{H} \end{array}$$

25. A method according to Claim 18, wherein the thermal curing step and the ultraviolet curing step are carried out simultaneously.

26. A method according to Claim 18, wherein the thermal curing step is started before the ultraviolet curing step.

27. A method of preparing a cured coating, comprising the steps of:
applying a composition to a substrate to form an uncured coating having a bulk liquid portion and a liquid to air interface;
curing the coating thermally; and
5 curing the coating with ultraviolet radiation,
wherein the composition contains a component which is ultraviolet curable and thermally curable, and wherein the concentration of the component is greater in the liquid to air interface than in the bulk liquid portion of the uncured coating.

28. A method according to Claim 27, wherein the thermal curing step is started before the ultraviolet curing step.

29. A method according to Claim 27, wherein the thermal curing step and the ultraviolet curing step are carried out simultaneously.

30. A method according to Claim 27, wherein the composition applied to the substrate contains a component comprising an amino resin core; and as substituents on the core,

5 more than one olefin functional group,
at least one silicon-containing group, and
at least one group selected from the group consisting of alkoxyalkyl, alkylol, and mixtures thereof.

31. A method according to Claim 27, wherein the ultraviolet curable component comprises the reaction product of

(a) an amino resin comprising reactive groups selected from the group consisting of alkoxyalkyl, alkylol, and mixtures

5 (b) an olefinically unsaturated compound having a functional group reactive toward the reactive groups of the amino resin;

(c) a silicon-containing compound having a functional group reactive toward the reactive groups of the amino resin.